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An Indo-Pacific tonnid (Gastropoda: Tonnidae) recorded from the Galapagos Islands

by

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With 3 figures

ABSTRACT

Tonna perdix (Linnaeus, 1758), an Indo-Pacific tonnid, is newly recorded in the eastern Pacific. An empty shell was collected in the Galápagos Islands by the FNRS — Belgian expedition to the archipelago in 1984. The role of passive dispersal by ocean currents for the pelagic larvae of Indo-Pacific gastropods occurring in the Panamic Province is discussed. Also, there is a possibility that the larvae of several *Tonna* species can be transported eastward across oceans by currents.

INTRODUCTION

Several authors have noted the Indo-West-Pacific affinities of a small part of the Panamic marine mollusc fauna (HERTLEIN 1937; HERTLEIN & EMERSON 1953; ROBERTSON 1976*a*) or even have reported true Indo-Pacific faunal elements among populations of molluscs in the eastern Pacific, mainly on offshore islands like Clipperton, Revillagigedo, Cocos, Guadalupe, and the Galápagos (EMERSON 1967, 1968, 1978, 1982, 1983; EMERSON & OLD 1965, 1968; HERTLEIN & ALLISON 1960; ROBERTSON 1976*b*; SHASKY 1983).

This paper reports the discovery of an empty shell of *Tonna perdix* (L., 1758) at the Beagle Islands, Galápagos.

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DESCRIPTION OF THE SHELL

(Figure 1, *a* and *b*)

The Galápagan record of *Tonna perdix* is based on one empty shell collected by Miss B. Burns on 15 July 1984 during the FNRS — Belgian expedition to the Galápagos.

The shell was collected with the aid of scuba in water less than 40 feet deep among coral heads and sand, at the Beagle Islands. Though it was partially broken and algae-covered, the shell has characters allowing me to identify it as *Tonna perdix:* the shell is rather elongate, moderately globose, and has a narrow umbilicus and a deep suture; the whorls are moderately convex; the last whorl shows 17 broad flat spiral ribs, brown to pinkish buff, separated by narrow whitish spiral grooves; the brown spiral ribs are very flattened; they are ornamented with whitish axial bars that are crescent- or chevron-shaped; these white markings are numerous and regularly spaced. The early post-embryonic whorls are dark-brownish.

The existence of two distinct species in the *perdix* complex is actually admitted, one in the Indo-Pacific Province and one in the western Atlantic (TURNER 1948).

The western Atlantic species is *Tonna maculosa* (Dillwyn, 1817) and the Indo-Pacific one is the true *Tonna perdix* (Linnaeus, 1758) (HANLEY 1859; BAYER 1937). These two species are somewhat similar, but can easily be separated on the ground of conchological characters: *T. maculosa* is light-brown, heavily mottled with darker shades and long white patches, interrupting the brownish coloration on the ribs; two or more joined ribs often

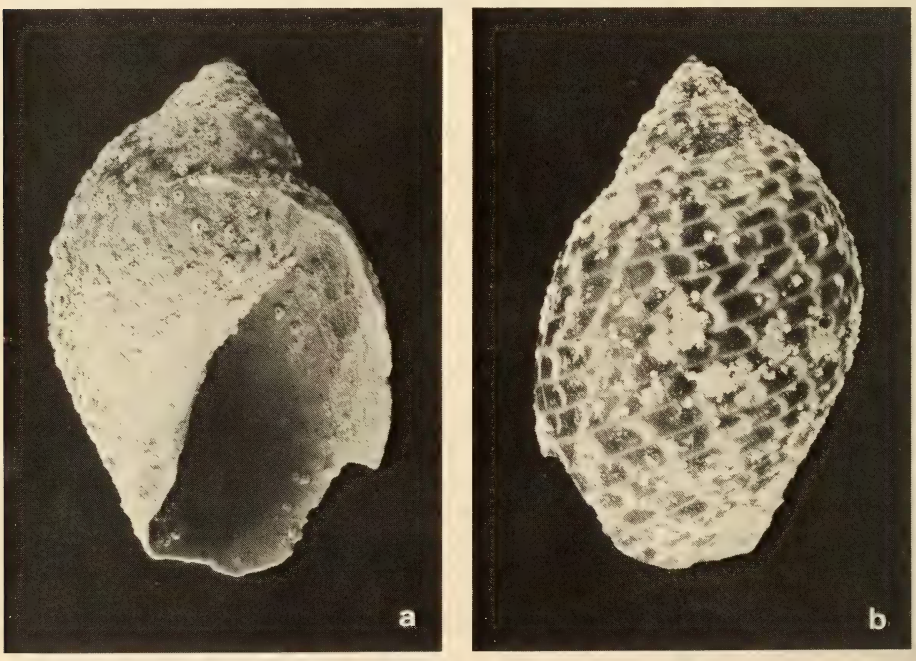

FIG. 1.

Tonna perdix (Linnaeus). Beagle Islands, Galapagos. Shell 80.4 mm high.
a: apertural view. b: dorsal view.

have a coinciding colour pattern; the sculpture consists of about 20 to 24 spiral ribs, which are separated by moderately deep grooves; these grooves generally appear to be brownish due to the remainder of the thin periostracum. The whorls are convex and sometimes a little flattened at the suture. *T. perdix* differs from *maculosa* essentially by its mottling pattern: the brown coloration of the ribs is interrupted by white and thin axial bars which are generally crescent- or chevron-shaped, sharply defined and more regularly spaced than the irregular-sized patches of *T. maculosa;* there are no darker shades accompanying these white markings; the spiral grooves between the ribs are entirely white and very shallow; the ribs are only slightly pronounced; they are defined more clearly by the colour pattern, while in *maculosa* they are clearly defined as a sculptural character by the deeper interspaces. The ribs of *T. perdix* are also less numerous: usually 16 to 20. *T. perdix* has generally less convex whorls and a more produced spire than *T. maculosa.*

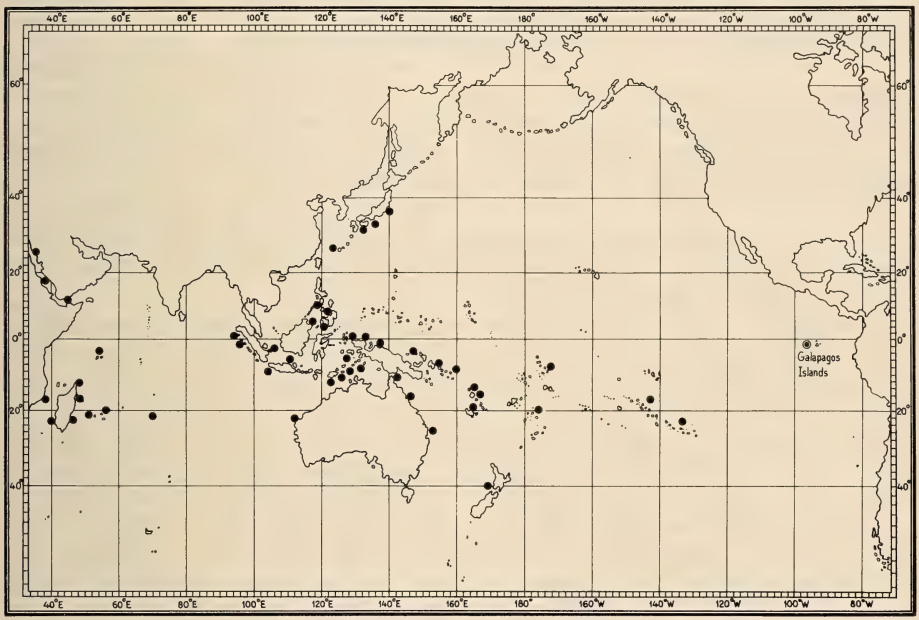

FIG. 2.

Distribution of *Tonna perdix* in the Indo-Pacific Province.

The conchological characters of the aperture and of the outer lip of the Galápagos shell are not utilizable, owing to the very bad condition of the apertural side of the specimen. However, the other available characters of the Galápagos shell (see description above) are sufficient to confirm its assignment to *T. perdix* and not to *T. maculosa.* On the other hand, the combination of its characters excludes a confusion with any other recent Indo-West-Pacific species of *Tonna.*

Figure 2 shows the distribution of *Tonna perdix.* Previously known only from the Indo-West-Pacific (TURNER 1948) not farther east than the Gambier Islands (KILIAS 1962), this is the first record of this species in the Galápagos (cf. FINET 1985), and in the

eastern Pacific, since it is recorded neither from other offshore islands nor from the West coast of the mainland. Moreover, it is not only a new record for the species in the eastern Pacific, but also for the genus.

The specimen has been deposited at the "Institut Royal des Sciences naturelles de Belgique", in the Galápagos dry collection (IRScNB n° 26800/109).

DISCUSSION

The discovery of an empty shell of *T. perdix* in the Galápagos does not prove that the species is actually living in the archipelago. However, even though the shell is very battered on the apertural side, its dorsal side is in rather good condition: glossy, shiny and full-coloured (the zones of incrustations excepted); it does not seem to be a fossil. Besides, there is no fossil record of this taxon in the New World tropics.

The hypothesis of a relict population of *T. maculosa* that would once have been more widespread or of a common ancestor of both *T. perdix* and *maculosa* can be rejected in consideration of the unequivocal *perdix* characters of the shell. The record of this unique shell from the Galápagos might probably be explained by an unusual or even accidental arrival of the Indo-Pacific *T. perdix* in this archipelago.

Each year, collectors and scientists report new species of Indo-Pacific marine molluscs that have been found on several East Pacific offshore islands or even, for some of them, on the West American mainland. These species are thus stated to have succeeded in crossing EKMAN's "East Pacific Barrier".

There seems to be no evidence that these species have been brought to these localities by man (HERTLEIN 1937). EMERSON (1967), SCHELTEMA (1966, 1968, 1971*a* & *b*, 1972), WYRTKI (1965, 1967) and ZINSMEISTER & EMERSON (1979) have emphasized the role of passive dispersal by ocean currents for shallow water benthic invertebrates having long pelagic larval stages (= teleplanic larvae, SCHELTEMA 1971*b*). According to EMERSON (1978), "these dispersal mechanisms have been postulated as the primary vehicle to account for the presence of the Indo-Pacific element in the modern Panamic fauna".

Such a dispersal mechanism has been extensively studied and quantified in North Atlantic waters. LAURSEN (1981), in his study of the distribution of teleplanic prosobranch larvae in the North Atlantic, has shown that such larvae, originating from the Caribbean Sea and the American East coast, begin to drift across the North Atlantic, and are carried eastward in the warm waters of the Gulf Stream. About 50% of the western Atlantic species studied reach the eastern North Atlantic waters, and more than 35% of these species are found in the North Equatorial Current going back from West Africa toward South America and the West Indies.

The duration of such a drift in the North Atlantic is estimated to vary between 4 and 13 months for an Atlantic crossing from west to east (ROBERTSON 1964; SCHELTEMA 1971*b*) and between 4 and 6 months for a crossing from east to west (SCHELTEMA 1971*b*).

In the Pacific Ocean, fewer data are available; the way followed by veligers from the western Pacific that have reached the Galápagos is not yet known, and may vary seasonally. It seems that there is no possible **direct** transport from the western or central Pacific to the Galápagos by an eastward flowing current (like the North Equatorial Countercurrent), except possibly by the Cromwell Current, which is not a surface current, being submerged at depths between 50 and 300 m. (EMERSON 1967; WYRTKI 1967). But even if many Indo-Pacific elements in the Galápagos have colonized the archipelago by

transport from other areas in the eastern Pacific, which are in the way of more direct currents from the west, like Clipperton Island, these Indo-Pacific elements had to reach these areas by crossing EKMAN's East Pacific Barrier.

The North Equatorial Countercurrent, a surface current flowing east between 4° and 11° N, is a possible way for teleplanic gastropod larvae to go from the western to the eastern Pacific waters around Clipperton, Cocos Island and the Central American coast, up to the Gulf of Panama.

WYRTKI (1965) reports a velocity of about 0.75 knots for the Equatorial Countercurrent between 130° and 110° W. In reality, the velocity of this current varies seasonally (Figure 3); the current may break into separate sections during some periods of the year, or even disappears entirely, as in April (WYRTKI 1965).

But using an average velocity of 0.75 knots as a basis for calculating duration of an eastward drift by the Equatorial Countercurrent, a reasonable estimate of this duration would be 5 to 6 months for a Pacific crossing from the Line Islands (West-Central Pacific) to Clipperton Island, and 8 to 9 months for the same crossing to the eastern Pacific waters off Costa Rica around Cocos Island.

Since the great majority of prosobranch teleplanic larvae, particularly tonnid larvae, are usually caught at depths from 15 to about 100 m (see DANA — Expedition in the Atlantic; LAURSEN 1981), and since the North Equatorial Countercurrent is almost completely concentrated in the upper 200 m (WYRTKI 1967), it is realistic to suspect that this surface current may transport the larvae.

It seems to be significant that the shallow-water Indo-Pacific molluscs known to have reached the eastern Pacific are almost entirely gastropods, and that the majority of these belong in the families Architectonicidae, Cypraeidae, Bursidae, Cymatiidae, Coralliophilidae, Mitridae and Conidae. These families are known to have long pelagic larval stages. *Tonna perdix* is the first representative of the family Tonnidae to have been transported from the western to the eastern Pacific as far as the Galápagos Archipelago. But this does not seem unlikely. According to ROBERTSON (1976*c*), "some of the advanced mesogastropods (many of the Cassidae [helmet shells], Cymatiidae [tritons], Bursidae [frog snails], and **Tonnidae**) have extra large veligers which can survive in the plankton for very long periods of time and be transported great distances by ocean currents; all these have four remarkably long, extensible velar lobes". THORSON (1961) also mentions that genera like *Cypraea, Lamellaria, Tonna, Cassis, Charonia, Cymatium,* and *Bursa* have veligers which live long and grow vigorously during their pelagic phase.

Little is known about the life history of most species of *Tonna.* Several authors (MACDONALD 1855; SIMROTH 1895) have figured and described *Tonna* larvae, which were known under the generic name *Macgillivrayia* Forbes, 1852. FISCHER (1863, 1887) correctly assigned it to *Dolium (= Tonna) perdix* (Linnaeus, 1758).

Perhaps the best known larvae of the genus *Tonna* are those of the two equatorial Atlantic species encountered in the Gulf Stream: *Tonna maculosa* (Dillwyn) and *Tonna galea* (Linnaeus).

LEBOUR (1945, text fig. 22, p. 475) has figured and described the veliger and newly metamorphosed animal of a *Tonna* from the Bermuda Islands, identified as *T. perdix.* The reference to *T. perdix* seems doubtful, because the species is not known in Bermuda. It seems more likely that the description applies to *T. galea,* which has an early intermediate larval stage very similar to that illustrated by Lebour.

SCHELTEMA (1971*b*) and LAURSEN (1981) have given accurate descriptions and illustrations of the larval shells of *Tonna galea* and *Tonna maculosa.*

The larvae of the North Atlantic Tonnidae are known to be eurythermal, surviving in the rather low temperatures of the North Atlantic Drift. The only limitation to the distance that they may be carried is the length of pelagic life in relation to current velocity (SCHELTEMA 1971*b*).

Less is known about the survival of *T. perdix* larvae in Pacific currents, but it seems reasonable to apply the same conclusion to this species. Moreover, the Equatorial Countercurrent carries tropical surface waters usually warmer than 25 C (WYRTKI 1967). Though some factors other than temperature may limit the distribution of the larvae of *T. perdix,* it seems safe to conclude that the main limiting factor to the distance of their drift is the length of their pelagic life, related to the Equatorial Countercurrent velocity.

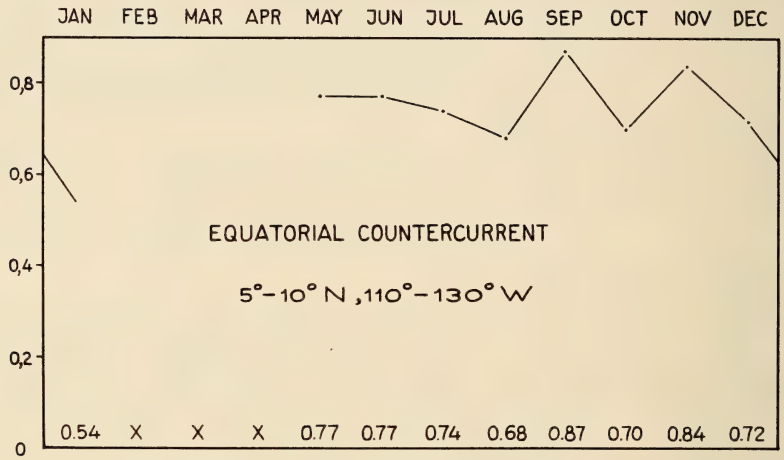

FIG. 3.

Seasonal variation of the average velocity in different areas of the eastward flowing Equatorial Countercurrent. The velocity is given in knots (adapted from WYRTKI 1965).

Although little is known about the duration of larval stages of *T. perdix,* SCHELTEMA (1971*b*) reports the following estimations for the duration of the total pelagic life of the northern Atlantic Tonnidae: 242 days for *Tonna galea* and at least 198 days for *Tonna maculosa.* According to the same author, these durations are probably underestimated. Though the development and growth may be faster for *T. perdix* larvae in the warm waters of the Pacific Equatorial Countercurrent, an estimate of 7 months for the entire pelagic life does not seem unrealistic. This duration is sufficiently long to account for the dispersal of the larvae from the West-Central Pacific (Line Islands), at least to Clipperton Island (see above). However, the species is not known to occur at Clipperton Island, nor on other eastern Pacific coasts or islands.

Of course, the probability of a larva drifting eastward and surviving long enough to be able to settle in a suitable ecological niche is very small. But species of *Tonna* are known to produce egg masses with 300 000 to 600 000 eggs at a time, several times a year (SCHELTEMA 1971*b*), so that even if the frequency of long-distance dispersal for individual larvae is very low, it seems possible for a few of them originating in the western Pacific to reach the Panamic region.

The discovery of living specimens of *Tonna perdix* in the tropical eastern Pacific still is needed to confirm this hypothesis. The existence of relays for dispersal in the Panamic Province other than the Galápagos, in other words the occurrence of the species at other stations like Clipperton, Cocos Island, or the western coast of Central America, has also to be verified. The absence of such records may be due to the ecological niches already being filled, leaving no room for *T. perdix,* or to the environment being unsuitable for the settlement of their post-larvae.

Although the eastward transport of teleplanic gastropod larvae across the tropical Pacific Ocean must be extensive, there is still a proportionally poor representation of Indo-Pacific adult molluscs in the eastern Pacific; the definitive evidence of the contribution of a cross-Pacific transport to the dispersal of Indo-Pacific species to the Galápagos remains thus a question for further investigation.

RÉSUMÉ

Tonna perdix (Linnaeus, 1758), un Tonnidae appartenant à la faune indo-Pacifique, a été découvert dans le Pacifique oriental, sous forme d'une coquille vide récoltée aux îles Galápagos, lors de l'expédition de 1984 du Fonds National de la Recherche Scientifique (Belgique). Le rôle joué par les courants océaniques dans la dispersion des larves pélagiques de gastéropodes de l'indo-Pacifique rencontrés dans la province panamique est discuté. Les possibilités pour les larves de plusieurs espèces du genre *Tonna* d'être transportées par les courants d'une extrémité à l'autre des océans en zone tropicale et subtropicale sont évaluées.

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